# BRIDGE MID -PERFORMANCE PERIOD REPORT

2018 – 2022 ACTUALS AND TARGET

MDOT established Bridge Performance Management Targets for bridges carrying the NHS as required for the National Federal Highway Program Performance Goals. This document describes how MDOT determined the two- and four-year targets from asset management analyses and procedures and reflecting investment strategies that work toward achieving a state of good repair over the life cycle of assets at minimum practicable cost. This document reports on the actual performance at the Mid-Performance Period and recommends changes to the 2022 Target.

2018 MEASURED
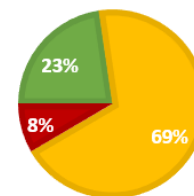**PERCENT BY NHS DECK AREA**

33%
10%
57%

Good   Fair   Poor

2020 MEASURED
PERCENT BY NHS DECK AREA

26%
6%
68%
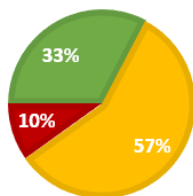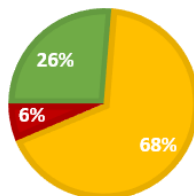
Good   Fair   Poor

2022 ADJUSTED TARGET
PERCENT BY NHS DECK AREA

23%
8%
69%

Good   Fair   Poor

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Executive Summary

TPM REQUIREMENTS

Infrastructure Condition is one of the national Federal highway program performance goals as established by Congress. The goal is to maintain the highway infrastructure asset system in a state of good repair. As part of this endeavor, targets were required to be set for NHS bridge conditions. These targets are the conditions that we expected in the short term (two- and four-years) as we apply our strategies to achieve our long-term goals given fiscal constraints and competing needs between all the performance management areas and assets. This report documents the progress of MDOT, our bridge authorities, and local agencies in meeting the NHS bridge condition targets.

TARGETS

Using deterioration modeling and analysis of programmed projects, MDOT predicted that the percentage of deck area on the NHS in Good condition would decline, the percentage of deck area in Fair condition would increase and the percentage of deck area in Poor Condition would decrease. Targets were set based upon this information, allowing for uncertainties, and are presented in Figure 1.
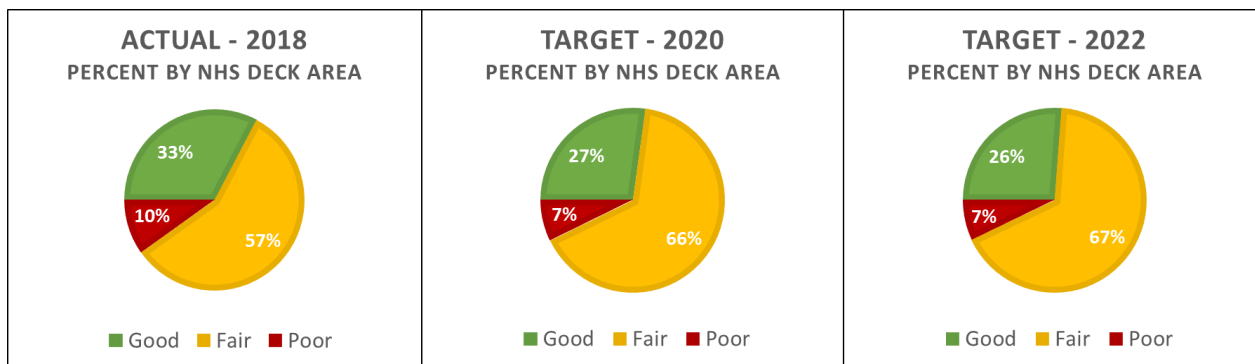

Figure 1: Original Recommended Bridge Targets

MID-PERFORMANCE PERIOD

The baseline condition reported for 2018 reflected NHS NBI data through March 14, 2018. The mid-performance period condition reflects NHS NBI data through March 13, 2020. The actual conditions report in March of 2020 were **26.3%** in Good condition, **67.5%** in Fair condition and **6.2%** in Poor condition, by deck area. This is within 1% of the predicted target values, and the Poor condition performance exceeded the target condition. The major factor leading to the Good condition target being missed was the impact of four large deck area bridges deteriorating into Fair condition faster than predicted. This will be discussed in further detail.
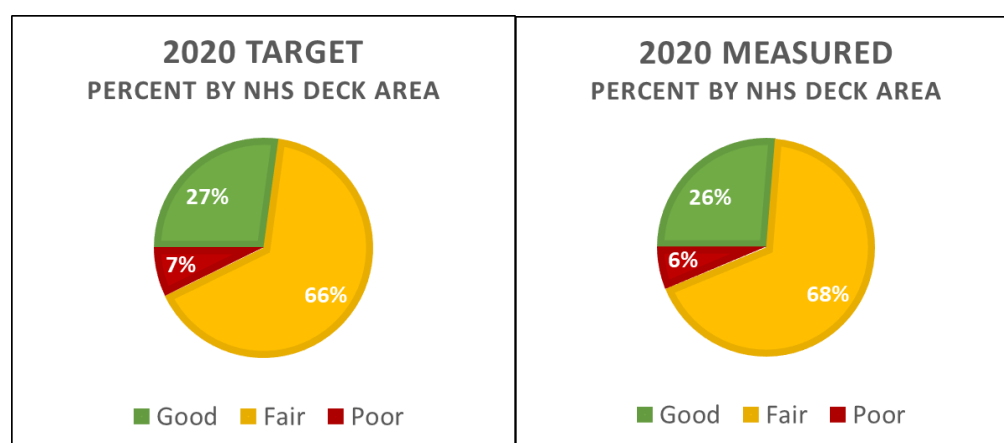

Figure 2: 2020 Target vs 2020 Measured

During the timeframe, the inventory changed slightly as owners continued to manage their bridges through projects and inspections. 235 bridges were removed, added, or modified leading to changes in bridge counts and deck area. Table 1 reflects the changes in the inventory from the 2018 baseline data to the 2020 mid-performance period data. In general, the number of NHS bridges increased while the total deck area decreased. The percent change both by count and by area is less than 1% of the total NHS area.

	2018		2020		Percent Change	
Owner	Count	Deck Area	Count	Deck Area	Count	Deck Area
Trunkline	2,729	32,936,116	2738	32,792,958	0.3%	-0.4%
Authority	8	1,998,482	8	1,998,482	0.0%	0.0%
Local	225	2,425,951	221	2,361,559	-1.8%	-2.7%
Total	2,962	37,360,549	2967	37,152,999	0.2%	-0.6%

Inventory Changes - 2018 to 2020 - Statewide

Table 1: Inventory Changes – 2018 to 2020 - Statewide

MID-Period Condition Report

NATIONAL BRIDGE INSPECTION STANDARDS

Federal law, outlined in the National Bridge Inspection Standards (NBIS), defines a bridge as a structure carrying traffic with a span greater than 20 feet and requires that all bridges be inspected to monitor and report condition ratings. The FHWA requires that for each applicable bridge, the performance measures for determining condition be based on the minimum values for substructure, superstructure and deck or culvert.
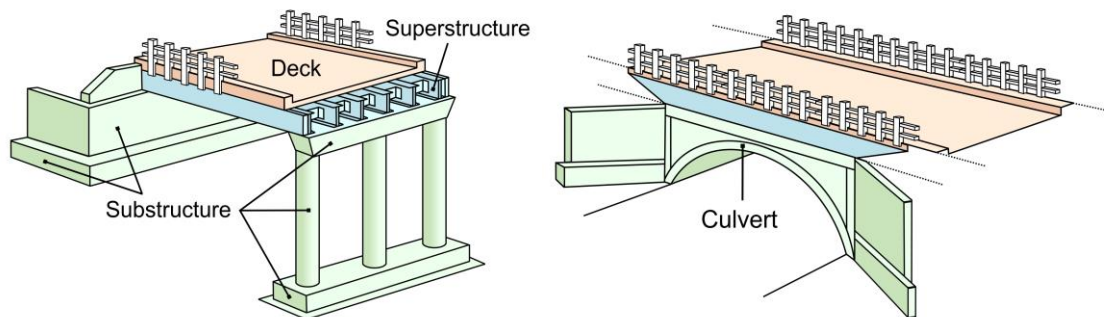

Figure 3: ANATOMY OF A BRIDGE OR CULVERT

Condition ratings are based on a 0-9 scale and assigned for each culvert, or the deck, superstructure and substructure of each bridge. These ratings are recorded in Michigan's National Bridge Inventory (NBI) database through a web-based system called MiBRIDGE. According to Federal standards, ratings of 7 and above are in Good Condition, 4 and less are in Poor Condition, and the remainder are in Fair Condition. Condition ratings are an important tool for transportation asset management as they are used to identify preventative maintenance needs and to determine rehabilitation and replacement projects.

NBI Condition Ratings		
7-9	Good Condition	Routine maintenance candidate.
5-6	Fair Condition	Preventative maintenance and minor rehabilitation candidate.
4	Poor Condition / Poor	Major rehabilitation or replacement candidate.
2-3	Poor Condition / Serious or Critical	Emergency repair or high priority major rehabilitation or replacement candidate. Unless closely monitored it may be necessary to close until corrective action can be taken.
0-1	Poor Condition / Imminent Failure or Failed	Major rehabilitation or replacement candidate. **Bridge is closed to traffic.**

Table 2: NBI CONDITION RATINGS

MID-PERFORMANCE PERIOD NHS BRIDGE CONDITIONS

Structures that meet the definition of a bridge according to the NBIS are recorded in the Michigan Bridge Inventory database through a web-based system called MiBRIDGE. MDOT's Bureau of Bridges and Structures (BOBS) in turn submits this information to the National Bridge Inventory (NBI). Using this database, BOBS compiles the number of bridges and deck area for each of the categories required by the Performance Management requirements. While the National Bridge Inspection Standards applies to all publicly owned highway bridges, the Transportation Performance Management Targets are only applied to those bridges carrying routes on the National Highway System (NHS) including bridge on- and off-ramps connected to the NHS. The FHWA requires counting the NHS condition by the respective deck area of each bridge and express condition totals as a percentage of the total deck area of bridges in a state. The area is computed using the NBI Structure Length and Deck Width or Approach Roadway Width (for some culverts). Tables 3 and 4 represent the data submitted to the FHWA on March 13, 2020.

Mid-Performance Period NHS Bridge Condition by Count – Statewide								
Owner	**Good**		**Fair**		**Poor**		**Total**	
Trunkline	752	27%	1828	67%	158	6	2738	92%
Authority	3	38%	5	63%	0	0%	8	<1%
Local	83	38%	100	45%	39	17%	221	7%
Total	838	28%	1933	65%	196	7%	2967	

Table 3: Mid-Performance Period NHS Bridge Condition by Number of Bridges – March 2020

Mid-Performance Period NHS Bridge Condition by Deck Area - Statewide								
Owner	**Good**		**Fair**		**Poor**		**Total (sft)**	
Trunkline	8,719,688	27%	22,092,484	67%	1,980,786	6%	32,792,958	88%
Authority	291,482	15%	1,707,000	85%	0	0%	1,998,482	5%
Local	756,411	32%	1,282,990	54%	322,158	14%	2,361,559	6%
Total	9,767,581	26%	25,082,474	68%	2,302,994	6%	37,152,999	

Table 4 Mid-Performance Period NHS Bridge Condition by Deck Area – March 2020

The majority of structures by both count and deck area are owned by MDOT Trunkline. The three bridge authorities – the International Bridge, the Mackinac Bridge, and Blue Water Bridge own only 8 structures, but those 8 structures comprise 5% of the NHS deck area statewide. Local agencies are responsible for 7% of the NHS population by count and 6% by deck area. While these numbers are small in comparison to the proportion within the trunkline program, the expected deterioration and improvement of Bridge Authority and Local Agency bridges must be considered when setting Performance Management Targets.

MID-Period Progress Toward Targets

COMPARING MEASURED AND TARGET VALUES

The Mid-performance period condition reflects NHS NBI data through March 13, 2020. The actual conditions report in March of 2020 were **26.3%** in Good condition, **67.5%** in Fair condition and **6.2%** in Poor condition, by deck area. This is within 1% of the predicted Target Values, and the poor condition performance exceeded the target condition.
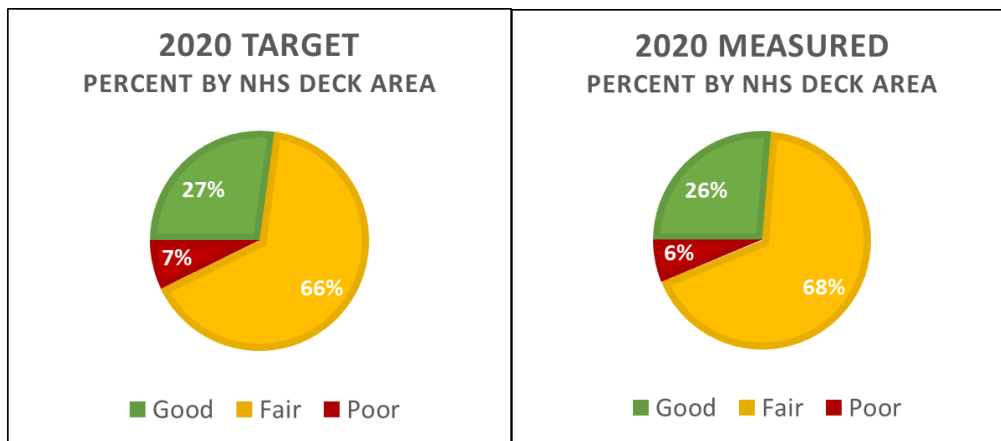

2020 TARGET
PERCENT BY NHS DECK AREA

27% · 7% · 66%
Good · Fair · Poor

2020 MEASURED
PERCENT BY NHS DECK AREA

26% · 6% · 68%
Good · Fair · Poor

Figure 4: 2020 Target vs 2020 Measured

EVALUATING GOOD CONDITION

The target for Good condition was set as a combination of estimating the deck area that was expected to deteriorate and the deck area that was expected to be improved. This is demonstrated in Figure 5, which shows that 8.8% of the NHS deck area was predicted to leave Good condition and 2.3% was expected to enter Good condition during the time period. As shown, the Good condition deck area was predicted to decline and the mid-performance period target was set at 27.0%. However, the measured decline was slightly larger than predicted with a resulting Good condition by deck area of 26.3%. This 0.7% difference is 260,000 sft of deck area. The prediction for the 27.0% deck area in Good condition correlated to 23.4% of NHS bridges in Good condition by count. In 2020, the actual number of NHS in Good condition was significantly higher – 28.2%. This means that the reduction in Good deck area as compared to the target is less about the number of bridges that were maintained in Good condition, and more dependent on how large the bridges are that deteriorated. When analyzed by count instead of deck area, both the Good and Poor target were exceeded.
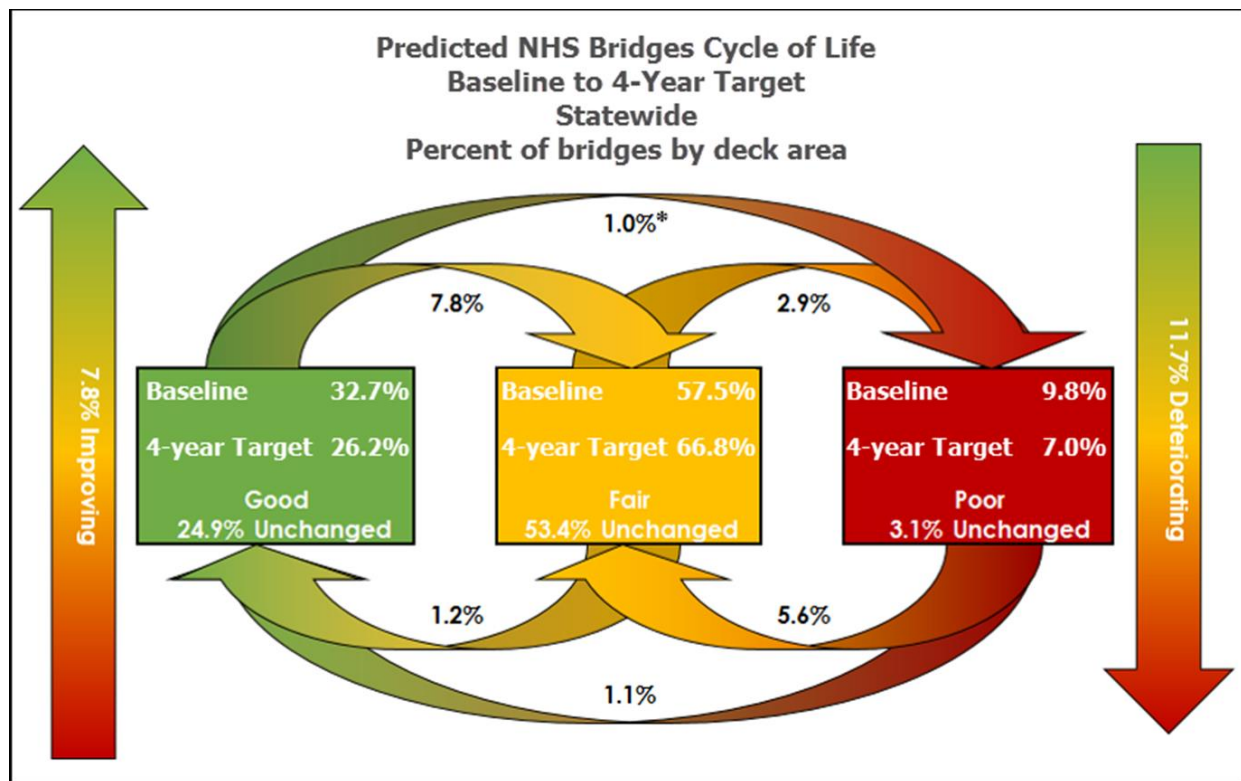
Figure 5: Baseline to 4-Year Target Predicted Cycle of Life

GOOD BRIDGE DETERIORATION

Four "big bridges" deteriorated from good condition to fair condition during this performance period. As discussed when setting the targets, when measuring by deck area the impact of only a few signature structures can significantly impact the uncertainty within projections. The four bridges that fell to fair condition sum to 1.43M sft of deck area, or just under 4% of the Statewide NHS deck area. Additionally, these structures had extenuating circumstances which make it challenging to perform condition projections as refined of a level as two-years. The two Zilwaukee bridges are segmental concrete box girders. Michigan has few of these structure types and so there is significant uncertainty in the prediction of deterioration rates. The other two structures were found to have Alkali Silica Reactivity (ASR) damage in the substructure, which leads to accelerated deterioration.

MID-Period Investment Strategy

TAMP INVESTMENT CONSISTENCY ANALYSIS

As part of the requirements of the Transportation Asset Management Plan, MDOT performs an investment consistency analysis each year. This analysis demonstrates implementation of MDOT's TAMP. MDOT project selection is guided by investment strategies from the TAMP to make progress toward achievement of its targets for asset condition and performance of the NHS. The agency's Investment Consistency Analysis shows an alignment between MDOT's actual investment levels based on budgeted project obligations from FY 2018 to 2019 for specified work types, and MDOT's planned levels of investment included in the TAMP for these same work types.

Bridge Investment - 2018 and 2019		
Trunkline (NHS and Non-NHS)	TAMP Allocations	Obligated Funds
Reconstruction	$154 M	$208 M
Rehabilitation	$81 M	$55 M
Preservation	$68 M	$66 M
Authorities and Local Agencies (NHS only)	$41 M	$39 M

Table 5: TAMP Investment Consistency Analysis

Implementation of bridge projects in FY 2018 exceeded the reconstruction investment estimate in the initial TAMP. This was primarily a result of two bridge replacements that accounted for $62 million. One of the bridges was rated in serious condition and the other bridge was scour critical. Considering these factors, the agency is satisfied that the constrained bridge strategy included in the initial and final TAMP for years 2018 and 2019 have been implemented within reasonable expectations due to changing conditions and circumstances and while maintaining a risk based asset management strategy.

Target Adjustment

DEVELOPING TARGETS

Starting from the condition reported with the NBI submittal on March 14th of 2018, the expected improved condition from projects and reduced condition from deterioration was summarized into expected condition in 2020 and in 2022. The deck areas in good, fair and poor conditions at each year were summarized. To account for uncertainty, the amount of deck area in good condition was conservatively reduced by 1%, and the amount of deck area in poor condition was increased by 1%. A 1% reduction for uncertainties reflects about 30 average size structures that either deteriorated faster than predicted or that did not see as much of an improvement as predicted.

Unfortunately, four of the bridges that deteriorated faster than predicted dwarfed the 1% reduction planned for uncertainties. If the four large deck area structures had remained in Good condition, then the NHS Good Condition Target would have been exceeded at a value of 30.1%. To account for this unforeseen circumstance and to bring the 2022 targets in alignment with current conditions, the target setting analysis was repeated by combining the current condition (therefore accounting for the bridges that deteriorated faster than predicted), the predicted deterioration rates of the remaining bridges as well as the expected condition following programmed projects.

ADJUSTING TARGETS

The 2018 and 2020 measured values and the updated 2022 Targets are shown in Figure 6. Overall, the number of Good bridges is expected to decline significantly as preservation efforts tend to extend life in Fair condition. Additionally, there is a large population of bridges that have exceeded the expected time in Good condition. By applying the statewide median time, they are predicted to fall to Fair condition at any time, and so they are reflected as in Fair condition in the targets. It could be that unique factors or preservation activities have extended the time in Good condition for these structures.

TARGET ADJUSTMENT

2018 MEASURED
PERCENT BY NHS DECK AREA
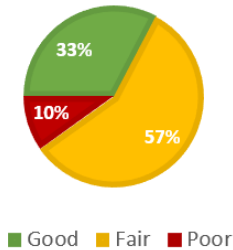
2020 MEASURED
PERCENT BY NHS DECK AREA
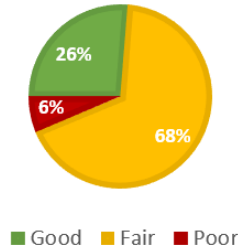
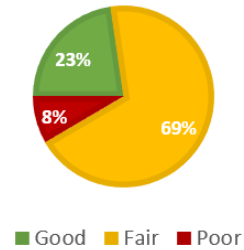**2022 ADJUSTED TARGET**
PERCENT BY NHS DECK AREA

Figure 6: Proposed Targets – 2020 analysis

The amount of bridges in Good condition is predicted to decrease and the amount of deck area in Poor condition is predicted to increase. This is consistent with previous targets, except it accounts for the deterioration of the big bridges discussed previously which account for nearly 4% of the NHS deck area statewide. The amount of Fair deck area will require a sustained commitment to preservation in order to prevent an unsustainable amount of fair bridges from falling into poor condition.

MPO Coordination

The MPO's established targets supporting the State DOT's statewide bridge performance targets. As part of the Full Performance Period Progress Report, MPOs will report their established targets, performance, progress, and achievement of the targets to their respective state DOT in a manner that is agreed upon by both parties and documented in the Metropolitan Planning Agreement. The MPOs are not required to provide separate reporting to the FHWA. However, State DOTs and MPOs will need to coordinate and mutually agree to a target establishment reporting process. The minimum penalty threshold requires that no more than 10% of NHS bridges measured by deck area be classified as structurally deficient.

MDOT provided estimated condition for each MPO's population of bridges, however it was not recommended that they were adopted as specific targets. As discussed earlier, predicting deterioration applies statewide average deterioration rates to all bridges. Some bridges will deteriorate faster while some will deteriorate slower. At the network level, these differences tend to balance. When looking at smaller populations, the difference between specific bridge deterioration and statewide averages can lead to large differences between predictions and measured values. When the performance values are measured in terms of deck area rather than count, large bridges can exacerbate this discrepancy.

MDOT also created a Transportation Performance Measures Dashboard for MPOs and bridge owners to aid in reviewing targets. The 2018 baseline data can be found at https://mdot.maps.arcgis.com/apps/webappviewer/index.html?id=26ddc82bc9634e05a055cd4a6747818f. The 2020 data can be found at https://mdot.maps.arcgis.com/apps/webappviewer/index.html?id=91289b5580114648a4ae0b4d002c565b. These pages represent a snapshot of data at the time of the NHS bridges in the NBI submittal to FHWA, and is what will be used by FHWA to evaluate the targets. For more current information, all NBI bridge data is updated monthly at https://Michigan.gov/bridgeconditions .

MPO COORDINATION

	Good		Fair		Poor		Total	
MPO	Deck Area	Percentage	Deck Area	Percentage	Deck Area	Percentage	Deck Area	Percentage
Battle Creek Area Transportation Study	3,429	1%	420,446	92%	31,722	7%	455,597	100%
Bay City Area Transportation Study	112,658	18%	426,620	70%	74,079	12%	613,357	100%
Genesee County Metropolitan Planning Commission	133,738	7%	1,508,951	79%	257,875	14%	1,900,564	100%
Grand Valley Metropolitan Council	1,488,565	38%	2,257,585	58%	176,016	4%	3,922,166	100%
Jackson Area Comprehensive Transportation Study	90,300	21%	268,966	64%	60,932	15%	420,198	100%
Kalamazoo Area Transportation Study	234,944	44%	238,508	45%	57,426	11%	530,878	100%
Macatawa Area Coordinating Council	72,176	24%	230,927	76%	0	0%	303,103	100%
Midland Area Transportation Study	41,128	21%	154,375	79%	0	0%	195,503	100%
Saginaw Metropolitan Area Transportation Study	544,567	24%	1,722,253	75%	41,708	2%	2,308,528	100%
Southeast Michigan Council of Governments	5,712,390	35%	9,619,314	58%	1,115,618	7%	16,447,322	100%
Southwest Michigan Planning Commission	28,277	3%	1,000,380	96%	17,444	2%	1,046,101	100%
Niles-Buchanan-Cass Area Transportation Study	4,965	2%	254,801	98%	0	0%	259,766	100%
Twin Cities Area Transportation Study	23,312	3%	745,579	95%	17,444	2%	786,335	100%
Tri-County Regional Planning Commission	93,825	4%	1,922,819	84%	268,451	12%	2,285,095	100%
West Michigan Metropolitan Transportation Planning Program	179,670	27%	473,386	71%	16,298	2%	669,354	100%
Outside MPO Boundaries	1,031,914	17%	4,837,944	80%	185,375	3%	6,055,233	100%
All NHS	9,767,581	26%	25,082,474	68%	2,302,944	6%	37,152,999	100%

2020 Measured Condition on the NHS by Deck Area